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THE ECOLOGY OF SYMPHYLA*

BY A. E. MICHELBACHER
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Introduction

The class Symphyla has held the interest of naturalists since about the middle of the eighteenth century. Most of the early studies were concerned with taxonomy, anatomy and phylogenetic relationships of the group. While these subjects still attract attention, important papers dealing with the economic and ecological aspects have appeared. However, the class is a small one and, generally speaking, its study has been neglected. Greatest interest in the group has been stimulated by the fact that many investigators believe Symphyla to be a type similar to that from which the insects have arisen. Comparative studies have shown that symphylans have many characters in common with the lower insects.

The ecology of the group is poorly known, and is difficult to study because of its soil-inhabiting nature, small size, and the fact the individuals are fragile and easily injured. The subject is one that challenges the imagination and because the field has been only lightly touched, it offers a fertile subject for investigation. In this discussion the present knowledge concerning the general ecological aspects of the group is considered. If emphasis of the large number of gaps in our knowledge of the group should stimulate further ecological studies, its purpose will have been served.

Description and Life History

Symphylans are small, white, soft-bodied, centipede-like organisms, with 12 pairs of legs, although in some the first pair is reduced to wart-like structures. They are regarded as having 15 body segments, and the genital opening is just anterior to the fourth pair of legs. They have prominent antennae and at the

*Presidential address read before the Pacific Coast Entomological Society, December 18, 1948.

posterior end of the body there is a pair of functional spinnerets. Depending upon the species, they measure from about 2 to 9 mm in length.

Symphylans reproduce from eggs and the newly hatched individual has 6 pairs of legs although Tiegs (1945) reported *Hanseniella agilis* Tiegs as having 7 pairs. Molting occurs from time to time and an additional pair of legs is added with each subsequent molt until the full complement of legs is obtained. During this developmental period, body segments, scuta and antennal segments are added. At least with *Scutigerella immaculata* (Newport) molting continues at intervals during the entire life of the organism, and a single individual has been known to cast its skin as many as 52 times. To a certain point, at least, the individuals increase in size with each molt, and segments are added to the antennae. Members of the group are long lived and, in the laboratory, reared specimens have survived for more than four years. Reproduction is most active during the spring and summer. The population starts to increase in the early spring and under favorable conditions continues upward through the summer. As reproduction ceases, the population starts to decline, and usually reaches its lowest ebb in the late winter or just before reproduction gets well under way in the spring.

Distribution

Symphylans are widely distributed in nature. They are found under many climatic conditions, and are likely to be encountered everywhere except in the arctic regions. However, they appear to be most abundant in the warmer temperate and tropical regions. Some species are adapted to desert areas, others to humid regions. They occur in cultivated as well as uncultivated soils. Some prefer grassland, others forested or shrub-covered terrain. They are likely to be encountered from below sea level to at least an elevation of about 10,000 feet. At Point Reyes, *Symphylella essigi* Michelbacher has been collected in fair abundance at about high tide level. Actually there are species which occur in localities well below sea level, for *Scutigerella palmonii* Michelbacher was described from specimens collected in Palestine on the bank of the River Jordan near its emergence from the Sea of Galilee, which is more than 600 feet below sea level. *Scutigerella immaculata* (Newport) and *Symphylella subterranea* Michelbacher both occur sympatricly in the delta region of the Sacramento

River which ranges from less than 10 feet above to 15 feet below sea level. Symphylans are also found well distributed in the high mountains of California, and in Europe both Verhoeff (1933) and Friedel (1928) have reported collecting *Scutigerella immaculata* (Newport) at an elevation of 3000 meters.

Some species are found most abundantly in the surface soil, some appear to prefer the decaying forest litter and the soil just beneath it; still others are adapted to a wide range of movement in the soil, and some appear to prefer the subsoil. They are found in all soil types, which range from sands to clays and peats.

Symphylans apparently are unable to construct their own runways in the soil, therefore soil texture and structure greatly influence their distribution and abundance in localized areas. In general, they are to be found in greatest numbers where the soil structure is open. For this reason, uncultivated or undisturbed soils offer a more favorable environment for the development of most species than that encountered where cultivation is practiced. This is particularly true of those species which prefer the surface soil and it is possible that cultivation will so modify the environment of those species that inhabit the decaying forest litter and the soil just beneath it to a point where the species will no longer be able to survive.

Cultivation destroys the countless number of runways made by natural agencies such as decaying roots, and small soil-inhabiting organisms. Further, it alters the natural porousness and openness of the soil structure by producing changes in the crumb structure.

The changes produced by cultivation also probably exert an influence on those species of symphylans that range through the entire soil horizon and into the subsoil. However, most of these species are well adapted to living under conditions of soil cultivation and are often found present in cultivated fields in large numbers.

The symphylan that has received the most attention is *Scutigerella immaculata* (Newport). This species ranges from just under the surface of the soil to a depth of 4½ feet. It is well adapted to living in the subsoil, and in cultivated fields this zone furnishes a most favorable retreat. A large portion of its life is spent here, as is attested by the tremendous number of molted skins found in the runways. This species also ranges freely

through the cultivated zone, and its movements are little hampered unless this soil horizon is thoroughly packed. It will move into the cultivated soil and destroy germinating seeds. However, if at planting time a tractor wheel passes over a row and thoroughly firms the soil, the germinating seed frequently escapes injury, due to the fact that the movement of the organism is greatly interfered with.

Symphylella subterranea Michelbacher is another species that is little affected by cultivation. Only rarely has it been taken in the first six inches of soil. It prefers the deeper soil and is likely to be found in most abundance below the 12 inch level, and therefore lives in a region seldom interfered with by cultivation.

Populations

The determination of symphylan populations is very difficult. Because they are so fragile and easily injured, it is difficult to recover them when a Berlese funnel is used. Because of this, a water flotation method of separation was developed (Michelbacher 1938). With this method it was determined that about 70 per cent of the individuals in a sandy silt soil could be recovered. On two occasions the efficiency of the above two means of separation were compared. In each survey 12 soil samples were run by each of the methods. In the first experiment a total of 157 symphylans were recovered by the water flotation method as compared to 17 for the Berlese funnel, and in the second, the ratio was 214 to 54. These tests definitely showed that the water flotation method was superior to the Berlese funnel. However, where a separation is desired from a sample containing considerable decaying forest litter or similar material, it is very possible that a Berlese funnel would give a more satisfactory separation because the debris contained in such samples would certainly interfere with the efficiency of the water flotation method.

Numerous population studies using the water flotation method have been conducted in the delta region of the Sacramento River and in greenhouses. In a field devoted to the production of field and truck crops the population of *Scutigerella immaculata* (Newport) was calculated to be 22,700,000 and that of *Symphylella subterranea* Michelbacher 2,705,000 per acre. In an adjacent field where the seasonal population trends were being followed, the

peak population of *Scutigerella immaculata* (Newport) encountered was 8,000,000 while that for *Symphylella subterranea* Michelbacher was 4,915,000. These last populations were determined from samples taken on July 16.

Large populations of *Scutigerella immaculata* (Newport) are frequently found in greenhouses. In one where snapdragons were being seriously injured by this symphylan the population on an acre basis was found to be 90,300,000. All the above populations were calculated from the actual number of symphylans obtained from the samples, and no factor was applied for the probable number of individuals not recovered. Similar substantiating studies were conducted by the author where large populations of *Scutigerella immaculata* (Newport) were found to occur.

The populations reported above are larger than those encountered by most investigators who have considered symphylan populations. However, large populations were reported by Van Zwaluwenburg (1931) who carried out investigations in the Hawaiian Islands. The species involved were *Symphylella neotropica* (Hansen) and *S. simplex* (Hansen). These symphylans averaged about 90 per surface square foot in a growing cane field as against 150 in a fallow series. This on an acre basis is equivalent to 3,920,400 and 6,543,000 respectively.

Although found in lesser numbers, Symphylans have figured in many investigations that have involved population studies of the invertebrate soil fauna. Among those reporting their presence are Morris (1922, 1927), Thompson (1924), Edwards (1929), Sawa (1930), Starling (1944) and Pearse (1946). The investigations were conducted under several environments which included pasture, grass, arable and forested land. Thompson (1924) in his investigations found that Symphyla constituted 86 per cent of the total Myriapoda population. Edwards (1929) also found them to be much more abundant than all the other myriapods combined. Other workers have found them to be less abundant than some of the other myriapods. Among these Starling (1944) reported Symphyla as constituting 9.2 per cent of the population, while Pearse (1946) reported them as composing 32.9 per cent of the myriapod population.

Based on population studies and observations it appears that symphylans are not rare as stated by Ross (1948) but are probably the most abundant of all the myriapods as far as the number

of individuals are concerned. Certainly they are found in large numbers wherever favorable environments are encountered.

Although individuals are found in abundance, the number of known species of Symphyla is not over 100. This paucity of species is due, at least in part, to the fact that the group has been badly neglected. In conducting surveys, undescribed material is frequently encountered, and it is but a matter of time before the number of named species will be greatly increased.

Some species have a rather wide geographical distribution. *Scutigerella immaculata* (Newport) probably has the widest known distribution, although some records that pertain to it apply to closely related forms. In my own experience this was true of certain specimens identified as *Scutigerella immaculata* (Newport) from various points in Europe which have proved to be new species.

Some species are widely distributed in California. Among these are *Scutigerella immaculata* (Newport), *Hanseniella vandykei* Michelbacher, *Symphylella essigi* Michelbacher, and *Geophilella americana* (Hilton), but present knowledge indicates that the distribution of many species is extremely limited. A number described from California are known only from the type locality. These include *Scutigerella linsleyi* Michelbacher, *Symphylellopsis alba* Michelbacher, *S. oviceps* Michelbacher and *S. longiseta* Michelbacher.

Some genera apparently have a wide geographical distribution, without being represented by many species. For example, *Geophilella* as known at present is represented by but two species. One of these was described from Europe and the other from California. Although widely separated the two species are extremely closely related, which would indicate that the genus is probably conservative. The same appears to be true of *Symphylellopsis* which contains but four species, three from Europe and the other from California. Here again the species are all very closely related, and show no marked divergence.

Food

The food habits of symphyla as a group are poorly known. On the whole they feed on a vegetable diet although some species, at least, will feed on animal matter. The subject is certainly in need of thorough investigation and a complete knowledge of the exact type of food preferred by the several groups of Symphyla must await these studies.

Food habits are best known in the case of *Scutigerella immaculata* (Newport). Newport (1845) and Latzel (1884) believed they fed upon the smaller soil-inhabiting arthropods. Williams (1907) thought that Protozoa which swarm over the decaying materials of a forest floor probably made up the major portion of their food. Later investigations have established that they are primarily vegetable feeders. They feed upon the roots of many of the higher plants, and even the foliage of some, if it is available. Michelbacher (1938) successfully reared them on the leaves of lettuce. There can be but little doubt that under moist conditions, and where the leaves of such plants as lettuce are in contact with the soil, *Scutigerella immaculata* (Newport) will come to the surface to feed. In such an environment they can sometimes be found just beneath the soil surface, or even beneath a leaf. Although *Scutigerella immaculata* (Newport) probably prefers succulent vegetation, they do feed on lower forms of plant life. Michelbacher (1938) noted that they fed heavily on compressed yeast, and believed that they fed on the unicellular green algae as well as fungi which grew on the substratum of the rearing dishes. He also noted that *Scutigerella immaculata* (Newport) ate any individuals that died and observed them feeding on injured specimens. The apparent ability of *Scutigerella immaculata* (Newport) to feed on the soil microflora probably accounts for their living in the absence of apparent food as has been observed by a number of investigators, including Wymore (1924) Friedel (1928) and Almeida (1930).

Higher plants certainly influence the distribution of *Scutigerella immaculata* (Newport) in the soil. They are attracted to growing vegetation, and population studies and other observations have shown them to be most abundant about growing plants. They will come up to just beneath the surface of the soil to feed on germinating seeds and young seedlings or recently transplanted plants, and occasionally, as already noted, they come to the soil surface to feed on leaves in contact with the soil. About growing plants they are found most abundantly within the top six inches of soil, while away from them they are found in greatest numbers in the deeper soil or subsoil.

Scutigerella immaculata (Newport) has feeding and non-feeding phases. These are associated with the molt and the non-feeding phase occurs during the critical premolting and molting per-

iod. Most food is consumed during the early period of each feeding phase.

Other Symphyla also feed on higher plants. Rand (1926) reported *Hanseniella unquiculata* (Hansen) as being injurious to sugar cane, and Takashima (1938) has also reported *Hanseniella* sp. as attacking this crop. However, there appears to be many symphylans that do not feed on living higher plants, and various investigators have believed their food to be decaying organic matter or humus. Although this may be the case, it seems more probable that they actually feed on the microflora and the saprophytic growth that arises from the humus and other organic material.

It has been shown that living higher plants exert no noticeable effect on certain species. This was clearly indicated in population studies that involved *Symphylella subterranea* Michelbacher (Michelbacher 1939). Samples of soil were taken along rows of growing plants and a similar set in the center of the space between rows. In the samples taken in the rows, 273 individuals were recovered as compared to 274 for the interspaces. Further, there was no evidence that the plants were attracting individuals to the surface layer of soil. From the above observations it appears certain that the principal food of this species must be something other than higher plants. In another laboratory conducted experiment it was found that *Symphylella essigi* Michelbacher did not appear to feed on lettuce, but fed heavily on compressed yeast.

Moisture

Moisture is one of the most important environmental factors affecting symphylans. They have relatively soft bodies, and are unable to withstand dessication. They apparently do best in moist soils, where the humidity is close to 100 per cent. Their distribution in the soil is largely influenced by the moisture content of the soil. Members of the class are most easily found when the surface soil is moist. Searching for them usually becomes more difficult as the soil dries out, and becomes discouraging when it has dried to a point where it is hard to work. Unless the soil can be easily handled and broken up for examination, the presence of symphylans is hard to detect. Due to their small size and fragile bodies, they are easily crushed or killed and difficult to find especially when searching for them under adverse conditions.

Of the symphylans studied, the moisture relationships of *Scuti-*

gerella immaculata (Newport) are best known. To a large extent this species moves up and down with the soil moisture, although some individuals are always likely to be encountered in the subsoil. They are, however, likely to be most abundant in the soil level which has a moisture content most favorable for the growth of plants. They will move into drier soil and have been encountered in such situations feeding on fleshy roots. They probably visit these locations just long enough to feed, after which they retreat to the deeper soil where moisture conditions are more ideal. The ability of *Scutigerella immaculata* (Newport) to live over a wide range in soil depths enables it to meet easily, changes in the soil moisture content. From its base in the deep subsoil *Scutigerella immaculata* (Newport) can move with ease to any horizon necessary to meet its need. An interesting vertical distribution of *Scutigerella immaculata* (Newport) was encountered in a field in late spring where a recent rain had wet the surface soil to a depth of four or five inches. The soil below this was dry for a depth of about 12 to 18 inches, beyond which it was moist. Symphylans were found in abundance in the surface and deeper moist soil, but none were encountered in the dry layer between.

Scutigerella immaculata (Newport) as well as other symphylans is not easily wet with water. Water is repelled and if trapped in the soil, they are enclosed in a tiny air bubble which affords them considerable protection from flooding. In these small air pockets the symphylans remain dry and can withstand submergence for a day or two to several weeks or longer. The length of time that they can survive depends largely upon the depth of water and temperature. In general, the period of survival decreases as the temperature rises. At low temperatures the survival period decreases as the depth of water is increased.

One point of interest is that if an air pocket containing a symphylan comes to the surface of the water it can be broken leaving the creature in a perfectly dry condition.

When land is flooded, *Scutigerella immaculata* (Newport) will, if possible, move up through the soil ahead of the rising water table, but will stop and be trapped by the rising water just under the surface of the soil. Where the soil is uneven they may congregate in large numbers just under the soil surface on the high spots. If these high spots are disturbed just before or after being flooded, symphylans will come floating to the surface of the water by the thousands. From limited observations it appears that most

species of symphyla are unable to move up ahead of a rising water table with the same ease as does *Scutigerella immaculata* (Newport). This is certainly true of *Symphylella subterranea* Michelbacher and is probably the case within all the genera where the individuals are not capable of rapid movement.

It is doubtful whether all symphylans are capable of moving as deep into the soil as does *Scutigerella immaculata* (Newport). If they are greatly restricted in their movement, the question arises as to how they survive when the soil dries out. This can not be answered at present but to speculate, it is possible that some may encyst as do certain of the millipedes. Certain habits and actions of *Hanseniella vandykei* Michelbacher lead to the belief that this might be the case.

Reaction to Light

Symphylans are eyeless and although negatively phototropic they tolerate light of low intensity. In laboratory breeding cultures of *Scutigerella immaculata* (Newport), which were stored on a shelf where the light intensity was low, individuals would come to the surface of the soil section and lie there perfectly motionless. They also did not hesitate to come to the soil surface to feed on lettuce placed there for food. However, they do try to avoid light of high intensity. This response is probably one of the main reasons that accounts for their stopping just beneath the surface of the soil when a field is flooded. Apparently they would rather face submergence than light of high intensity.

In the absence of eyes, symphylans apparently rely upon the sensory organs of their antennae to guide them through the soil.

The function of the spinnerets is not known. Some investigators, including Williams (1907b), Riley (1929), and Filinger (1931) believed that *Scutigerella immaculata* (Newport) lined their runways with silken threads, but this hardly appears to be the case. It is possible that some of the workers mistook fungus mycelia for silken threads.

Temperature

Symphylans are markedly affected by temperature. It influences their development and every phase of activity. Because of the insulating effect of their soil habitat they can tolerate a wide range in air temperature.

Investigations which have been conducted indicate that for normal activity the optimum temperature of their environment is betaween 12 and 20° C.

Conclusion

Only a brief review has been presented concerning the ecology of symphyla. The picture is still very incomplete and there are many gaps to be filled. Although there are many obstacles to be overcome in attacking the problem, it appears that these are not insumountable. Advances in rearing technique should go far in paving the way for additional studies. Because the field has been so poorly investigated, it offers a fertile opportunity for further study. Initiative and a well planned program should reap a rich reward.

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APHIDS IN RELATION TO QUICK DECLINE AND TRISTEZIA OF CITRUS

BY E. O. ESSIG
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The role of aphids as transmitters of plant virus diseases is becoming more important as a better understanding of these diseases is developed. Other plant troubles involving grafting and budding and the difficulties of combining two varieties or types of closely related plants as one are also entering into the complex. Just what the insects do in such cases is a problem that may require years of investigation.

The mysterious disease called "quick decline" of citrus in California and the so-called "*zonate chlorosis*" or "*tristezia*" of Brazil are thought to incriminate aphids as possible carriers and vectors.

The *tristezia* in Brazil is believed to be carried by the black citrus or camellia aphid, *Toxoptera aurantii* (Boyer de Fonscolombe), and the brown citrus aphid, *Aphis citricidus* (Kirkaldy). In South Africa, where a similar disease of citrus occurs, this latter aphid is known as *Aphis tavaresi* Del Guercio, but it is definitely a synonym of *A. citricidus,* which in its present role is fortunately a more descriptive name.

It is the purpose of this note to call attention to the aphids rather than to their possible role as transmitters of plant virus diseases.

Although these two species, representing different genera, are rather readily identified alive in the orchard as well as mounted specimens in the laboratory, yet they are really quite different anatomically and may be easily separated.

The most important and unusual character common to these two citrus-infesting species, not found in any other known aphids, is a net-like pattern (figs. 1, 3) on the venter of the abdomen on segments V, VI, and VII and especially under the bases of the cornicles. It may occupy much of the underside of one or more segments. This design consists of a matrix of somewhat parallel lines that branch, curve, and coalesce to form variously shaped linear and angular areas. Under high magnifications the posterior

margins of the fine lines appear toothed, like a saw (fig. 3). This network is easily visible on cleared specimens under high magnification. It has been noted by Theobald (1917, fig. 3; 1929, fig. 14), Blanchard (1925, fig. 5) [Chitizination on venter, not dorsum], Reiniger (1942) and Zimmerman (1948), who showed enlargements of the gross areas.

Differences

Aphis citricidus (fig. 1)	*Toxoptera aurantii* (figs. 2, 3)
1. Stigma of forewing pale	1. Stigma of forewing conspicuously black
2. Cubital or media vein 2-forked	2. Cubital or media vein usually 1-forked (rarely 2-forked)
3. Antennal segment III all black	3. Antennal segment III pale with extreme tip black
4. Antennal segment III with 10-20 scattered sensoria. Antennal segment IV with 2-4 sensoria	4. Antennal segment III with 6-8 circular sensoria in straight line. Antennal segment IV without sensoria.

The Brown Citrus Aphid

Aphis citricidus (Kirkaldy)
Myzus citricidus Kirkaldy 1907
Aphis tavaresi Del Guercio 1908
Aphis citricola van der Goot 1912
(fig. 1)

This dark tropical species was originally described in the genus *Myzus* by Kirkaldy (1907:100) from specimens taken on *Citrus* on the Island of Oahu, Territory of Hawaii. The following comments accompanied the description: "it is probably an introduction from China, and is very common on *Citrus* all over the Hawaiian Islands." As *Aphis tavaresi* it was named by Del Guercio (1908:143) on *Citrus* spp. collected in the region of Zambezi, Africa, by J. S. Tavares. Van der Goot (1912:273) also described the same species under the name *Aphis citricola*. His specimens were collected on *Citrus* in Chile by R. Paessler.

This is a relatively large dark brown or almost black species that may readily be confused with such other species as *Aphis gossipii* Glover, *A. cooki* Essig, *Toxoptera aurantii* (B. de Fonsc.) that also commonly occur on citrus.

It is reported to be the vector of the virus disease known as tristezia in Brazil.

HOST PLANTS

The brown citrus aphid has been taken chiefly on the various species of *Citrus*, but it has also been reported as feeding on the following plants: *Azalea, Cudrania triscuspidata, Diospyros kaki, Ficus carica, Poncirus trifoliata, Pyrus communis* (*?*), *Toddalia asiatica* and *Trema orientalis.*

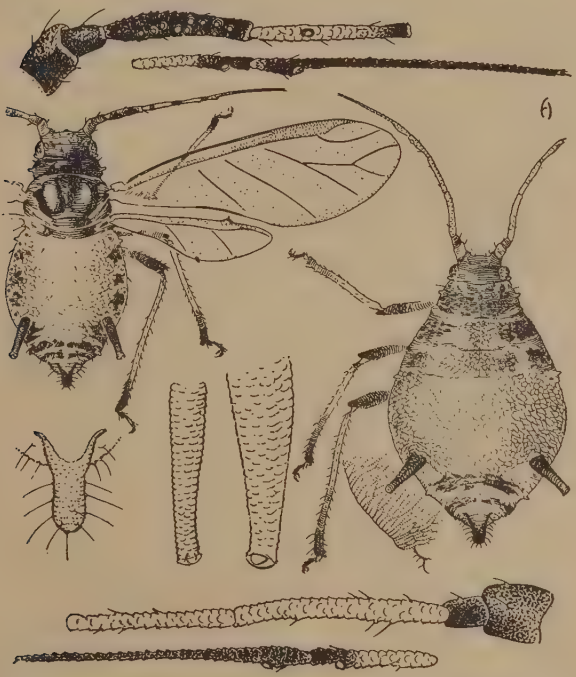

Fig. 1. *Aphis citricidus* (Kirkaldy). Anatomical characteristics of the alate and apterous forms. (Drawing by Frieda Abernathy).

DISTRIBUTION

The distribution of the brown citrus aphid is more strictly tropical than that of the black citrus aphid. It does not appear to have been as widely disseminated by commerce which may be accounted for by its less omnivorous habits and more restricted range of host plants.

The following localities have been noted:

AFRICA: Belgian Congo, British East Africa, Cameroun, French Congo, French West Africa, Gold Coast, Italian Somaliland, Kenya, Morocco, Mozambique, Nairobi, Nyasaland, Rhodesia, Tanganyika, Uganda, Union of South Africa.

ASIA: Ceylon, China (Chekiang, Fukien, Kaingsu, Kwangtung), Cyprus, French Indo China, India (Bengal, Madras, Mysore), Java, Loochoo, Japan, Malaya, Okinawa, Sumatra, Taiwan.

AUSTRALIA: West Australia.

CENTRAL AMERICA

EUROPE: Italy, Malta, Sicily, Spain.

NEW ZEALAND

PACIFIC AREA: Fiji, Territory of Hawaii, (Hawaii, Hilo, Kaui, Oahu, Maui), Mauritius, Samoa.

SOUTH AMERICA: Argentina, Brazil, Chile, Peru, Trinidad.

The Black Citrus Aphid

Toxoptera aurantii (Boyer de Fonscolombe) 1841
Aphis camelliae Koch 1843
Toxoptera aurantiae Koch 1856
Aphis coffeae Nietner 1880
Ceylonia theaecola Buckton 1891
Toxoptera theobromae Schouteden 1906
Aphis citrifoliae Shiraki 1913
(Figs. 2 and 3)

This medium-sized black species is characterized by white markings on the legs and antennae, the very prominent black stigma, usually the single-branched media or cubital vein of the forewings, and the net-like markings on the venter of the abdomen beneath the cornicles.

It is primarily a tropical and subtropical species extending its range into the warmer temperate regions in greenhouses, lathhouses, residences, and even out of doors in very favorable localities.

Although this species was used in a large number of tests in California by Dickson, Flock, and Johnson (1948) no transmission of quick decline has so far been observed.

According to Posnette (1944) it also transmits the swollen shoot disease of cacao in the Gold Coast Colony.

This species is highly susceptible to parasitism by *Aphidius confusus* Ashmead and related braconids in California and the

mummied bodies of the hosts may be found in great numbers on the curled leaves of the new trminal growth of the host plants.

HOST PLANTS

The black citrus aphid has a wide range of host plants and is especially abundant on and injurious to the various species and

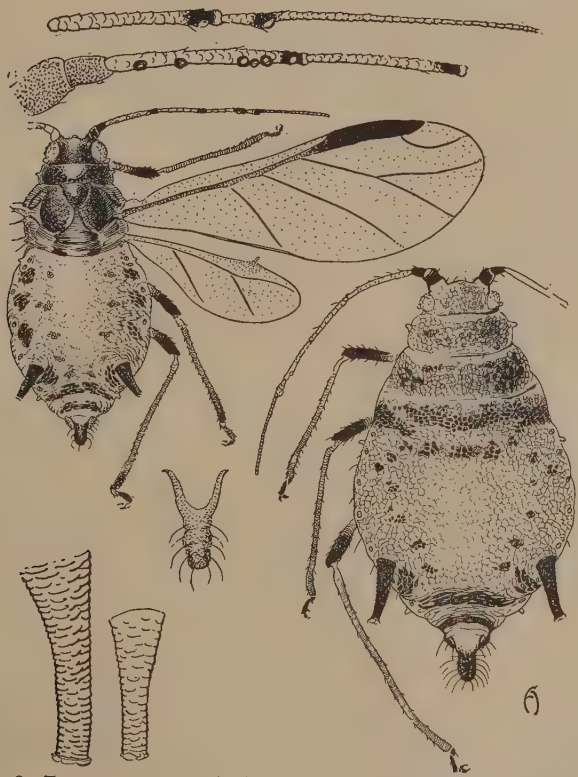

Fig. 2. *Toxoptera aurantii* (Boyer de Fonscolombe). Anatomical characteristics of the alate and apterous forms. (After Zimmerman, 1948).

varieties of *Cacao, Camellia, Citrus* and *Ficus*. A list of hosts include: *Acronychia pedunculata, Albizzia odoratissima, Algaia odorata, Alnus cordata, Anona squamosa, Antigonum, Apocynum,*

Ardisia sieboldi, Artabotrys odoratissimum, Artocarpus integrifolia (*A. integra*), *Berberis tenuifolia, Bidens pilosa, Butea fondrosa, Callophyllum inophyllum, Camellia caudata, C. drupifera, C. japonica, C. oleiferum, C. thea, Camomilla, Cassia glauca, Chincona, Citrus aurantifolia, C. aurantium, C. limonum, C. maxima, C. medica, Cladium, Coffea arabica, C. liberica, Cratoxylon polyanthus, Cydonia japonica, Distylium stellare, Ehretia buxifolia, Eugenia aquea, E. sandwicensis, Eucalyptus robusta, Evodia aromatica, Ficus aukeotsang, F. ampelos, F. aurantii, F. fovoelata, F. hispida, F. obscura, F. pumila, F. retusa, Gardenia florida, G. jasminoides, Helicia, Hibiscus arnottianus, H. rosasinensis, H. tiliaceus, Ilex anomala, I. aquifolium, I. rotunda, Illicium anisatum, Ixora macrothyrsa, Lagerstroemia indica, Lansium domesticum, Litchi chinensis, Loranthus, Macadamia, Macaranga tanarius, Magnolia grandiflora, Mangifera indica, Masea sinesnsis, M. tenera, Morus alba, Murraya exotica, Musea lanceolata, Myrsene lessertiana, M. sandwicensis, Nephelium lappaceum, Nesaea myrtifolium, Odina wodier, Oxalis, Panax, Pelea, Pellionia, Pittosporum glabrum, P. tobira, Plieogynium solandri, Pyrus communis, P. serotina, P. sinensis, Quercus, Randia spinosa, R. sinensis, Rhamnus alaternus, Sageretia theezans, Salix babylonica, S. warburgii, Sapota achras, Saraca declinata, Scaevola chamissoniana, Schima noronhae, Scolopia crenata, Severinia buxifolia, Straussia, Styrax japonicum, S. suberifolium, Symplocos sessilifolia, Thea caudata, T. sinensis, Theobroma cacao, Trema amboinensis, Trachelospermum jasminoides, Uvaria narum, Vaccinium varingiaefolia, Vanda, Viburnum odoratissimum, V. tinus, Xylosma racemosum* var. *Kwangtungensis, Zelkova schneideriana* (?).

Distribution

The distribution of the black citrus aphid comprises the tropical, sub-tropical and warmer temperate regions of the world wherever its important host plants occur. It is also a greenhouse inhabitant in the temperate regions. The following distributional list is probably only an indication of its true geographical range:

AFRICA: Belgian Congo, French Congo, German East Africa, Gold Coast, Italian Somaliland, Cameroun, Kenya, Morocco, Nyasaland, São Tomé, Tanganyika, Uganda, Union of South Africa.

ASIA: Caucasus, Ceylon, China (Chekiang, Fukien, Kwangtung), French Indo China, Georgia, India (Assam, Madras), Java,

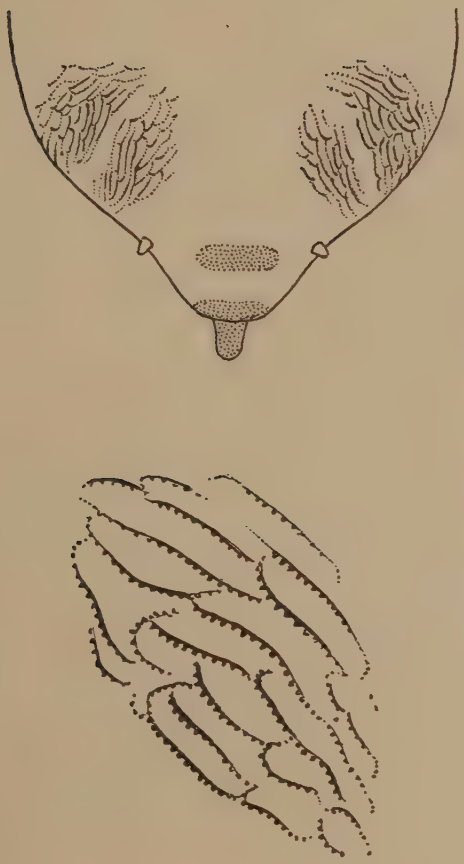

Fig. 3. *Toxoptera aurantii*. *Top*—net-like structures on venter of abdomen; bottom—enlargement of same to show saw-toothed structures. (Drawing by Frieda Abernathy).

Malaya, Palestine, Philippine Islands, Sumatra, Taiwan, Transcaucasia, Turkey.

AUSTRALIA: New South Wales, Queensland, Victoria, West Australia.

EUROPE: Italy, Malta, Spain.

NEW ZEALAND

NORTH AMERICA: Barbados, California, Cuba, Dominica, Florida, Guatemala, Mississippi, Montserrat, Puerto Rico, Santo Domingo, St. Thomas, Windward and Leeward Islands.

PACIFIC AREA: Fiji, Guam, Hawaiian Islands (Kauai, Oahu, Molokai, Maui, Hawaii), Samoa.

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OBSERVATIONS ON THE LIFE HISTORY OF CHLOROSEA BANKSARIA SPERRY

(Lepidoptera: Geometridae)

BY FREDERICK H. RINDGE
University of California, Berkeley

CHLOROSEA BANKSARIA Sperry

Chlorosea nevadaria, Packard, 1876, Mono. Geom., p. 378 (in part); Prout, 1932, Macrolep. World, 8:42 (not Packard, 1874).
Chlorosea banksaria Sperry, 1944, Can. Ent., 76:36.

This beautiful moth is widespread throughout the Pacific States from British Columbia to southern California and is of rather common occurrence in much of its range. Nevertheless, its life history does not appear to have been published.

A single larva of this species was obtained April 12, 1948, from beating *Ceanothus thyrsiflorus* Esch. in the vicinity of Kings Mountain, San Mateo County, California, at approximately 2000 feet altitude. This caterpillar was reared in the laboratory on the above food plant, pupation occurred April 29, and the adult emerged May 16, 1948.

Antepenultimate instar. Head width 0.8 mm., height 0.7 mm., length 0.3 mm. No further observations made.

Penultimate instar. Head rather small, the thorax and abdomen with prominent lateral projections on the segments. Head slightly bilobed, coarsely rugose, purplish-brown, with light brown on ocellar region and front of lobes. Labrum and antennae light green. Width 1.0 mm., height 1.1 mm., length 0.6 mm.

Thorax with very prominent dorsal and lateral protuberances. Prothorax anteriorly with very high median conical pair of projections, extending dorso-anteriorly over the head, and with smaller pair laterad of these; two smaller pairs of protuberances posteriorly along dorsum, the posterior of these being quite small and inconspicuous. Mesothorax with three pairs of median humps dorsally, the anterior two rounded swellings, the posterior a prominent pair of protuberances. Metathorax with single pair of small median lobes. Dorso-lateral margins of meso- and metathorax produced into prominent lateral extensions. Dorsally dark green, with purplish cast; all projections, swellings and lateral extensions purple; spiracular swellings orange-yellow. Laterally and ventrally light green. Legs purplish. Surface of thorax and abdomen heavily

granular, the granules with whitish cast, especially on sides of body. Setae on thorax and abdomen small, colorless.

Abdomen dorsally with anterior mid-line paired swellings on each segment, these being quite small and inconspicuous on anterior segments but increasing in size posteriorly, on last segment very high and conspicuous. Lateral margins of each segment produced into long prominent extensions extending laterally and upwards but not beyond anterior margins of segments, being most produced at anterior margins of segments and most prominent on segments two, three, four and five; on posterior three segments reduced to large rounded swellings. Dorsally dark green, slightly lighter than on thorax; tips and margins of lateral extensions purple, as are the mid-line paired swellings, these latter becoming more prominently marked with purple posteriorly, so that the last four segments are purple dorsally. Laterally, green as above except posteriorly on last three segments, these being purplish and including both prolegs. Ventrally, deep purple on segments three and four, bordered laterally by broad band of white granules. Spiracles light orange-yellow. Intersegmental membranes yellow-green. Anal plate greenish with slight pinkish-purple cast posteriorly.

Ultimate instar. Appears as before. Head width 1.5 mm., height 1.7 mm., length 0.8 mm.; subrectangular, only slightly bilobed, with anterior surface flattened. Setae small, inconspicuous; second posterior setae near vertex; second adfrontal setae on same level as first posterior setae; first adfrontal setae equidistant from second adfrontal and first posterior setae, closer to these than to frontal setae; anterior setae form slightly more than a right angle; ocellar setae form right angle; six ocelli well developed.

Body lighter green, matching the *Ceanothus* leaves; head and legs reddish brown; thoracic markings reddish; abdominal markings red-brown with purple cast. All setae very small, inconspicuous. Prothoracic setae Ia, Ib, IIa from large dorsal reddish protuberances; IIb from posterior base of protuberance bearing IIa; IV and V below spiracle. Mesothoracic setae Ia from dorsal reddish protuberance, Ib laterad of this; remainder of setae from lateral projections. Metathoracic setae similarly arranged.

Abdominal setae I from anterior protuberances except on first segment, II from inconspicuous base; on segments six and seven I and II more laterad than on preceding segments; setae I on eighth segment mounted on very prominent spine directed posteriorly; III dorso-anterior to spiracles on segments two to seven, while on segments one and eight they are dorsad; setae IV and V at extreme ends of wide lateral projections; VI posterior; VII and VIII in usual positions. Spiracles on second, third, fourth, fifth, seventh and eighth segments on dorsal surface; those on remaining segments on lateral surface.

The larva has the trembling or quivering motions as has been noted for others in this subfamily in the genera *Nemoria* (Comstock and Dammers, 1937; Comstock and Henne, 1940; Comstock, 1945), *Synchlora* (Comstock and Dammers, 1937) and *Cheteoscelis* (Hulst, 1888).

Pupa. Light green, more or less concolorous with food plant; head regions and posterior part of abdomen ventrally shaded with yellow-green; wing cases and appendages rugose. Cremaster of eight curved spines, subequal in length, arising from lateral margins of last segment; the latter ventrally with surface thrown up into numerous ridges. Spiracles elongate, slightly shaded with yellow-brown. Length 14 mm., width 4 mm. A day or two before emergence the abdominal spots of the adult show through very plainly, and the antennae and other appendages become darker along their margins. Pupation occurred on the food plant, in a delicate webbing between adjacent branches and leaves.

The larvae of *Chlorochlamys chloroleucaria* (Guenée) and *Nemoria rubrifrontaria* (Packard) have been described and illustrated in detail by Dethier (1942). The larva of *Chlorosea banksaria* Sperry may be distinguished from them by the following characters: Front of head more square and broader; first and second adfrontal setae equidistant from first posterior setae; third anterior setae on same level with first adfrontal setae, as are the second adfrontal setae and the first posterior setae; anterior setae almost form a right angle. The larvae of *Chlorochlamys* are without the prominent lateral thoracic and abdominal projections and so are immediately distinguishable. *Chlorosea* and *Nemoria* may be further differentiated in the body regions by the very small and inconspicuous setae of the former; and that the lateral abdominal processes do not extend caudad of their respective segments, and are truncate anteriorly, usually extending anteriorly at right angles from the mid-line when viewed from above.

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NOTES ON PARASITES OF CERTAIN MICROLEPIDOPTERA
(Gracilariidae)

BY J. W. TILDEN

The following leaf-mining Lepidoptera together with the enumerated parasites were reared in connection with the obtaining of material for a morphological problem.

The author is indebted to Dr. C. F. W. Muesebeck of the National Museum for determination of the parasites, and to Dr. Annette F. Braun of Cincinnati, Ohio, for the determination of the food plant variant of *Lithocolletis agrifoliella* Braun.

Lithocolletis nemoris Wlsm. This species is the common leaf miner of *Vaccinium ovatum* Pursh. The mines on the upper surface, and at first are flat and nearly spherical, becoming tentiform at last. Finally the entire upper surface of the leaf is mined and at pupation the upper epidermis of the leaf is thrown into three or more folds. Pupation is in a flattened coccon attached to the floor of the mine. The epidermis of the leaf may be removed, in most instances, without disturbing the cocoon. In many cases the lateral edges of the leaves are distorted and approach one another, so the leaves containing cocoons are trough shaped. This appears to be due to the drying of the upper epidermis after it becomes separated from the underlying tissues.

This species is heavily parasitized. Three genera of hymenopterous parasites were reared:

1. *Apanteles* sp., apparently undescribed. One parasite occurs per host larva, and upon reaching its growth, exits from the host and spins a pale yellowish cocoon in the mine but at some distance from the dead host. Upon emergence it exits from the leaf by a small circular hole in the upper epidermis of the leaf.

2. *Zagrammosoma* n. sp. (Eulophidae). This parasite emerged shortly after the material was brought into the laboratory and no notes were obtained.

3. *Chrysocharis* n. sp. (Eulophidae). The larvae of this species feed externally on the host and occur in fours. The growth is very rapid and in one case the larvae, which were very small when first noted, cast the meconium and pupated within four days. The pupae range from metallic blue to steel green in color, darkening to nearly black before emergence. The pupae are able to withstand considerable dessication, and will emerge normally even when the entire upper epidermis of the leaf is removed for observation.

Lithocolletis agrifoliella Braun. This was at first thought to be a new species, since it was reared from *Castanopsis chrysophylla* A. D.C. var. *minor* Benth. Dr. Annette F. Braun, however, regards it as a food plant variant of *agrifoliella* Braun, from the typical form of which it differs mainly by reason of a darker and richer coloration. This variant commonly mines the leaves of *Castanopsis* in the Sierra Morena (King Mountain) region of San Mateo County, California, forming upper surface mines of a similar form to those normally found on *Quercus agrifolia* Nee. This appears to be the first record of *Lithocolletis agrifoliella* Braun from *Castanopsis*.

This moth is parasitized by an undescribed species of *Chrysocharis* which closely resembles that found parasitizing *nemoris*. This parasite likewise occurs typically in fours, and may be the same species, since both hosts are found in the same area. The pupal stage is quite long, in sharp contrast to the larval stage, which is short. Pupation occurs in the mine of the host, but the larvae crawl to various parts of the mine before pupation. Four larvae which pupated on March 26, 1947, emerged as adults on May 16, a period of fifty-one days. The adults emerge from the mine by cutting minute holes in the upper epidermis of the leaf.

Gracilaria reticulata Braun. This is locally the commonest *Gracilaria* on *Quercus agrifolia* Nee, although it appears from rearings, that it is not the only species found on this oak. The mines are mostly on the under surface and near the edges, and are accompanied by considerable distortion of the leaf. Pupation may be in the mines, but more often the larvae let themselves down by silken threads and pupate in the duff below the tree.

From this moth was reared an unidentified *Gelis* sp. No notes were obtained.

STUDIES IN THE CANTHARIDAE III
(Coleoptera)

BY KENNETH M. FENDER
McMinnville, Oregon

When revisional work on the Cantharidae was begun some years ago, the author little realized the task he had assigned himself. It was thought at the time that the genus *Cantharis* was the only one of the larger genera requiring truly analytical study. Mrs. Fender (Dorothy McKey-Fender) was kindly permitted to accept this task. With the aid of Fall's work with *Podabrus*[1] and *Malthodes*[2] and Van Dyke's revision of *Silis*[3], the author's chore would be largely compilation. The inaccuracy of this line of reasoning has been indicated by the new species described by Brown[4] and Green[5, 6] as well as those of the author. Until conditions permit completion of the revisions, it is hoped that these studies will somewhat compensate for the lack.

The genus *Podabrus* can be broken down into eight groups on the basis of the ungual characters of the males. These characters hold true for only the first group in the females. In the other groups the claws of the females are the same—all claws toothed. Females of the first group have the claws similar to the males.

The many recently described species suggest a more convenient method of arranging the species for keying. Grouping the species and referring to such groups seems preferable to citing some certain couplet in Fall's key. The following key to males of the genus is offered to assist in the assignation of species to their groups. It is designed to avoid the rather terrifying first couplet of Fall which has seven parts, all but the first two parts requiring the study of all of the claws.

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[1]Fall, H. C., 1928, Ent. Am., 8 (n. s.): 65-103.
[2]Fall, H. C., 1919, Ann. Ent. Soc. Am., 12: 31-42.
[3]Van Dyke, E. C., 1918, Journal N. Y. Ent. Soc., 26: 161-179.
[4]Brown, W. J., 1940. Can. Ent., 72: 161-163.
[5]Green, J. W., 1947, Trans. Am. Ent. Soc., 73: 63-76.
[6]Green, J. W., 1948, Trans. Am. Ent. Soc., 74: 75-82.

KEY TO GROUPS OF PODABRUS (MALES)

1. Claws in both sexes armed with a long acute tooth causing them to appear broadly cleft.....Group I
– Claws either finely cleft or with a broad basal tooth or some combination of these 2
2. All claws armed with a broad basal tooth, the free angle of which may be rectangular or more or less acute .....Group II
– Claws of front tarsi finely cleft 3
3. Both claws of middle tarsi finely cleft 4
– At least one claw of middle tarsi toothed 6
4. All claws finely cleft .....Group III
– At least one claw of hind tarsi toothed 5
5. Both claws of hind tarsi toothed .....Group IV
– Outer tooth of hind tarsi toothed, all other finely cleft .....Group VIII
6. Both claws of middle tarsi toothed .....Group V
– Outer claws of middle tarsi toothed, inner claws finely cleft 7
7. Both claws of hind tarsi toothed .....Group VI
– Outer claws of hind tarsi toothed, inner claws finely cleft .....Group VII

The species of *Podabrus* described to date may be assigned to their groups as follows:

GROUP I

All claws of both sexes armed with a long acute tooth causing them to appear broadly cleft.

latimanus Lec.
ambiguus Fall
rugulosus Lec.
appendiculatus Fall
knobeli Fall
frosti Fend.
frater Lec.
cascadensis Fend.
comes Lec.
conspiratus Fall
illex Fall
pruinosus Lec.
limatus Fall
falli Hopp.
tomentosus Say
dreisbachi Green
tricostatus Say
punctulatus Lec.
flavicollis Lec.
quadratus Lec.
modestus Say
intrusus Say
longicornis Fall
diadema Fab.
brunneus Fend.
protensus Lec.
fayi Lec.
brunnicollis Fab.
binotatus Lec.
confraternus Fall
sierrae Fall
knowltoni Fend.
viduus Fall
fulvus Fall

pygmaeus Green
brevicollis Fall
fissus Lec.,
brimleyi Green
nothoides Lec.
basilaris Lec.
tenuis Fall
muleibris Fall
occipitalis Fall
mellitus Fall
modulatus Fall

GROUP II

All claws of both sexes armed with a broad basal tooth, the free angle of which may be rectangular or more or less acute.

extricatus Fall
lanei Fend.
tejonicus Lec. (?)
scaber Lec.
cinctipennis Lec.
limbellus Lec.
fumiganus Green
punctatus Lec.
excursus Fall
dietrichi Green
macer Lec.
piniphilus Esch.
puncticollis Kby.
extremus Lec.
brevipennis Lec.
xanthoderus Lec.
bolteri Lec.

tejonicus Lec. was described from a female and has been tentatively placed in this group by Fall.

GROUP III

All claws finely cleft in the male, in the female all broadly toothed at base.

fissilis Fall
vernalis Green

GROUP IV

Claws of male finely cleft on front and middle feet, toothed at base on the hind feet; in the female all broadly toothed at base.

lateralis Lec.
deceptus Brown
obscurevittatus Fall
secretus Brown
puberulus Lec.
simplex Lec.
pattoni Lec.
gracilis Fall
instabilis Fall
moestus Fall
tetragonoderus Fall
altus Fall

GROUP V

Claws of male finely cleft on the front feet, toothed on the middle and hind feet; all claws of the female toothed.

laevicollis Kby.
fenestratus Fall
probus Fall
citrinus Fall
perplexus Brown

GROUP VI

Claws of front feet of male finely cleft, of the middle feet outer claw toothed inner cleft, on the hind feet both claws toothed; all claws toothed in the female.

heteronychus Fall *furtivus* Fall

GROUP VII

Claws of the front feet finely cleft, of the middle and hind feet outer claw toothed inner cleft; all claws toothed in the female. *Podabrus danielsi* Fend. is our only known representative of this group.

GROUP VIII

Outer claw of hind feet of male toothed, all other cleft; all claws toothed in the female.

californicus Fend. *carmelensis* Fend.
lucidatus Fend. *rossi* Fend.
lutosus Lec. *corneus* Lec.
smithi Fend.
cavicollis Lec.

APHODIUS RECTUS MOTS. IN OREGON

(Coleoptera, Scarabaeidae)

The scarab, *Aphodius rectus* Mots., has been taken in fair numbers from cow dung in the Willamette Valley of Oregon. This species has been captured at Dayton and McMinnville with upwards of a hundred specimens having been collected. It has previously been recorded from East Siberia, Japan, China and Amur.

Two varieties are found here. The dark phase is almost entirely black occasionally with the elytral apices paler. The pale form has the elytra dark testaceous with the suture and a large triangular lateral area black, this latter dark area arising near the humerus, expanded to or almost to the suture at the apical fourth then rather abruptly truncated apically.

Drs. Ross and VanDyke and Mr. Hugh Leech of the California Academy of Sciences kindly compared this material with specimens in the Academy collection concluding that this is the species represented.—KENNETH FENDER, *McMinnville, Oregon.*

NOTES ON THE GROUP OF ANDRENA CARLINI COCKERELL, WITH DESCRIPTION OF A NEW SPECIES FROM CALIFORNIA

(Hymenoptera: Apoidea)

BY URLESS N. LANHAM
Department of Zoology, University of Michigan

The well-known *Andrena carlini* Cockerell is representative of a group of *Andrena* occurring throughout the United States which may be defined as follows:

Medium-sized to large species (11-13 mm. in length) with unbanded, nearly glabrous terga. Process of labrum large, entire or only slightly emarginate, not reflexed at tip, facial fovea broad; thorax finely sculptured, propodeal corbicula rather well developed, with interior hairy throughout, but no compact fringe of hairs anteriorly; trochanteral floccus perfect, tibial scopa with hairs of outer face simple; wings with first recurrent nervure ending near middle of second submarginal cell. Males with cheeks wide, mandibles decussate; genitalia with tips of parameres expanded, sagitta not flanged dorsally.

The very similar group of *A. vicina* Smith differs in having the trochanteral floccus imperfect (basal hears short, straight, not forming a part of the brush) and in having the tips of the parameres of the male genitalia narrow and strap-like.

The quite distinctive species described herein is characterized structurally among the species of the *carlini*-group (in the female) by the rather dull and closely, finely punctate clypeus and the triangular, narrowly truncate process of the labrum. In spite of the rather poorly developed trochanteral floccus, the other characters of female, such as the weakly produced metanotum (tending to be strongly protuberant in the *vicina*-group), and also the male genitalia, indicate the species to be a member of the *carlini*-group.

Andrena hurdi Lanham, new species

Female. Integument pure black; pubescence of dorsum of thorax, of pronotal lobes, of upper one-third of pleura, of nearly all of propodeum, and a few hairs on hind femora grayish white, with faint fulvous tinge, rest of pubescence black. Clypeus reticulate, rather dull, closely and finely punctate, punctures subcontiguous

to one pucture-width apart, no median ridge present, but a poorly developed median impunctate band apparent; process of labrum triangular, tip narrowly rounded or narrowly subtruncate, and slightly thickened; fovea extending well below dorsal margin of clypeus, tomentum black. Thorax with rather long pubescence; integument of mesoscutum nearly hidden by pubescence, dull, gran. ular, with very weak punctures; enclosure of propodeum almost hidden by pubescence at sides of the enclosure, surface finely reticulate, with a few weak wrinkles above, propodeal corbicula without conspicuously branched hairs along anterior margin; wings moderately darkened, tips darker than rest of membrane, nervures and pterostigma nearly black, second submarginal cell noticeably quadrate, the first intercubitus being nearly straight; tibial scopa somewhat looser than in *A. carlini*, spurs of hind tibia black, trochanteral floccus rather poorly developed for a member of the species-group. Terga reticulate, only slightly shining, finely, closely, and distinctly punctate, punctures on elevated portion of second tergum one to three puncture-widths apart, caudal fimbria black; pygidium broadly rounded at tip, central triangle coarsely reticulate. Length, 12 mm.; forewing, 10 mm.

Male. Head with cheeks one-half again as wide as eyes, broadly rounded; antennae with segment three distinctly longer than four, not quite as long as four plus five; hair of cheeks, of sides of face, and of face between antennae black, that of rest of head grayish white. Thorax with long pubescence, none black. Abdomen with numerous white hairs on first two terga, remaining terga with all of hairs black. Genitalia with tips of parameres moderately expanded, external margin not sinuate as in *carlini*, tip of eighth sternite distinctly emarginate. Length, 11 mm.; forewing 9 mm.

Holotype, female (Calif. Acad. Sci., Ent. No. 6118): Westley, Stanislaus County, California; 1 April, 1948; on *Brassica;* (P. D. Hurd). *Allotype*, male (Calif. Acad. Sci., Ent. No. 6119): same data as holotype. *Paratypes:* 5 females, 13 males. same data as holotype.

None of the females carried pollen loads.

A tentative key to those females of the *carlini*-group, which, like the present species, have the pleural hairs all or mostly black, follows:

1. Clypeus rather protruberant, with large, irregularly and rather sparsely distributed punctures; process of labrum very wide, broadly rounded ..... *carlini* Cockerell
– Clypeus not protruberant, with small, rather closely and more or less evenly spaced punctures; process of labrum broadly or narrowly truncate, or slightly emarginate, or triangular with narrowly rounded tip 2

2. Mesoscutum with transverse band of black pubescence between tegulae 3
– Mesoscutum without transverse band of black pubescence 4

3. Hairs of trochanteral floccus white to base, black band of mesoscutum rather inconspicuous ..... *cyanura* Cockerell
– Hairs of trochanteral floccus with basal one-half black, black band of mesoscutum conspicuous ..... *transnigra* Viereck

4. Clypeus more sparsely punctate, some punctures more than two puncture-widths apart ..... *regularis* Malloch
– Clypeus more closely punctate, punctures subcontiguous to one puncture-width apart 5

5. Process of labrum triangular, tip narrowly rounded; integument of terga pure black; propodeum without black hairs, except possibly on extreme lower margins..*hurdi* Lanham
– Process of labrum emarginate-truncate; integument of terga with slight bluish tinge; propodeum with considerable black hair, at least on dorsal fringe of corbicula and on sides of propodeum ..... *heterura* Cockerell

Mr. P. H. Timberlake has kindly compared paratypes of *A. hurdi* with the type of *A. heterura*, and found, in addition to the characters tabulated in the key, that *heterura* (female) has the pygidium acute and without sculpture (broad, reticulate in *hurdi*), and that the enclosure of the propodeum was smaller in *hurdi*, with the sides more arcuate; other differences were also apparent.

TWO NEW ICHNEUMONID HOST RECORDS

This note contributes new host records for two California Ichneumonidae.

Several larvae of *Prodenia praefica* Grote, collected from alfalfa near Tracy, California, in September, 1947, by C. Thompson, were caged and allowed to pupate. Two specimens of *Therion californicum* (Cresson) were reared from the pupae. Near Felton, California, on June 3, 1947, *Ephialtes ontario* (Cresson) was observed to oviposit in the pupae of the California oakworm *Phryganidia californica* Packard. From these collected parasitized pupae, the progeny of *E. ontario* emerged. The writer is indebted to H. K. Townes for determining the above Ichneumonidae.—K. S. Hagen.

PACIFIC COAST ENTOMOLOGICAL SOCIETY

E. S. Ross	A. E. Michelbacher	D. D. Jensen
Vice-President	*President*	*Secretary*

Proceedings

One Hundred and Ninety-seventh Meeting

The one hundred and ninety-seventh meeting of the Pacific Coast Entomological Society was held at 2:00 p.m., on January 17, 1948, in the entomological laboratories of the California Academy of Sciences, San Francisco. President Michelbacher in the chair. The following members were present: J. W. Tilden, E. A. Smith, W. D. Murray, J. R. Walker, A. E. Pritchard, R. C. Miller, R. L. Usinger, H. B. Leech, E. C. Van Dyke, C. D. Duncan, W. W. Hart, T. L. Fisher, E. O. Essig, W. W. Middlekauff, E. G. Meyers, R. J. Bartges, E. F. Quinnell, E. L. Kessel, R. E. Blackwelder, A. W. Larson, R. W. L. Potts, L. R. Gillogly, J. W. MacSwain, N. W. Hazel, H. T. Reynolds, O. G. Bacon, H. F. Madsen, A. J. Walz, R. L. Doutt, F. E. Skinner, D. B. Culver, E. S. Ross, P. H. Arnaud, K. S. Hagen, E. Hagen, M. Marquis, H. P. Chandler, R. Van den Bosch, R. F. Smith, H. Blakemore, A. E. Michelbacher and D. D. Jensen. Visitors were present as follows: D. B. Reddy, A. W. Macphee, A. G. Applegarth, L. M. Henry, G. L. Smith, E. G. Wegenek and C. P. Hoyt.

The minutes of the previous meeting were read and approved.

The membership committee proposed the following for membership in the Society: G. L. Smith, Laura M. Henry, E. G. Wegenek, and C. P. Hoyt. They were unanimously elected.

The membership committee proposed that in recognition of their long and distinguished service to the Society, G. F. Ferris, E. O. Essig and E. R. Leach be elected to Honored Membership, the Society's highest award. They were unanimously elected.

President Michelbacher announced the following changes in the membership of the standing committees: *Program*: A. E. Michelbacher and R. W. L. Potts released with E. L. Kessel and R. F. Smith appointed in their stead. *Membership*: A. E. Michelbacher and R. W. L. Potts released with J. W. MacSwain and Paul Harvey appointed in their places. *Historical*: R. W. L. Potts and H. B. Leech appointed as additional members of the committee. *Publications*: E. R. Leach appointed to fill the vacancy resulting from the death of Dr. F. E. Blaisdell. E. O. Essig and G. F. Ferris reappointed to the committee with terms to expire in 1950.

Professor E. O. Essig reported that he had received an indirect request for clothing to be sent to a German entomologist and his family who are in need of assistance. After some discussion Dr.

R. C. Miller moved that a committee be appointed to receive clothing for such purposes. The motion was carried unanimously and President Michelbacher appointed C. D. Duncan, O. G. Bacon and W. Hart to serve as such a committee.

In response to a call for notes and exhibits, Dr. E. L. Kessel displayed a cerambycid larva of the genus *Ergates* which was collected alive in a piece of two by four timber being used in the construction of a house. A large burrow had been made in the wood by the larva.

J. W. Tilden exhibited an adult longicorn beetle, *Tragidion armatum* Lec. which had been collected as a larva from yucca by George Mansfield, in March, 1941, at Borego Valley in San Diego County. The larva had been carried to San Jose where it was reared to maturity in a petri dish. It emerged as an adult in July, 1941.

J. W. Tilden also exhibited first instar nymphs of a cicada, *Platypedia* sp., which had hatched from eggs at Stanford University in September, 1947.

President Michelbacher then introduced the main speaker of the meeting, Mr. Hugh B. Leech who spoke on "The Canadian Forest Insect Survey." His remarks are abstracted as follows:

The Canadian Forest Insect Survey, long envisioned by officers of the Forest Insect Unit of the Division of Entomology, became an actuality in 1935, and owed its start to an introduced pest. In 1930 the European spruce sawfly (*Gilpinia hercyniae* (Hartig), the *Diprion polytomum* Hartig of earlier reports), was found in the Gaspé Peninsula of New Brunswick, the first record for North America.

By 1935 it had almost completely defoliated 6,000 square miles of spruce in the Gaspé, and had spread into Ontario and to New York State. Its appearance in Ontario brought it to the attention of moneyed lumbering interests, while its rate of dispersal suggested that it might even reach the Pacific Coast via the northen coniferous forests.

Under such conditions, money yearly asked for by the entomologists suddenly became available. A cooperative survey project was started in 1935. The Forest Insect Unit provided advice and supervision, laboratory facilities, and specialists in insect identification; the Dominion and Provincial Forest Services and allied services, and the forest industries, provided the personnel necessary for wide coverage of the country.

In 1936 the Survey was extended to British Columbia, by which time laboratory (and organizational) centers were at Frederickton, N. B., Ottawa, Ont., Winnipeg, Man., Indian Head, Sask., and Vernon, B. C. Later, the chief Forest Insect Laboratory for Canada was built, in cooperation with the Province of Ontario, at Sault Ste. Marie, Ont., and it is now the administrative center for the Survey.

At first, all cooperators were asked to make one or more collections a month, June through September, from spruce trees.

Later they were asked to make two or more for each of the four months, and to sample all the important coniferous and deciduous trees in their areas. Special reports on any noticeable insect activities were requested.

As the data obtained in the Survey began to show its value in dollars and cents, especially with reference to an extensive and intensive outbreak of the spruce budworm, a larger budget was granted to the Forest Insect Unit. This allowed use of the survey technical personnel for nearly full-time administrative and research work. A new classification, that of Forest Insect Ranger, was established. It called for non-technical men, preferably married, with high school but not university education, and experience in the woods. These men are now the backbone of the Surveys; they work chiefly in pairs, and are assigned to definite territories. They make regular and special collections, patrol by land, water, and air, investigate reported outbreaks, establish and service permanent sample plots, cruise timber, map infestations, etc. During the winter they work up field data, submit reports, outline work for the next season, cruise timber, and attend a course of lectures on general and forest entomology. Those of each center are answerable to a Chief Ranger, not to the technical personnel; the coordinator for the entire Survey has headquarters at Sault Ste. Marie, Ontario.

Transportation has been a major problem. Where the terrain permits or enforces it, outrigger canoes and larger boats are used; elsewhere, chiefly 4-wheel drive army vehicles (HUP's), which will be replaced as more desirable models become available. Through the generosity of the cooperating services, rangers go as passengers on various car, boat and plane trips, often to areas not usually accessible.

With trained rangers making a good proportion of the monthly collections, the field data are more accurate and have broader coverage each year. With increased personnel, the significance of the work in forest conservation and industry, and in pure research, will be increasingly important. The Survey attempts to provide forewarning of outbreak of forest pests, and, partly in preparation for the control thereof, the bionomics of each species of forest insect.

During the talk Mr. Leech gave details of the collecting, rearing, labelling, indentification, and building up of a collection. Stress was laid on personnel problems and on the basic dependence of the work on taxonomists.

After a discussion of the paper, the meeting was adjourned.—D. D. JENSEN, *Secretary.*

One Hundred and Ninety-eighth Meeting

The one hundred and ninety-eighth meeting of the Pacific Coast Entomological Society was held at 2:00 p.m. on February 28, 1948, in the entomological laboratories of the California Academy of

Sciences, San Francisco. President Michelbacher in the chair. The following members were present: A. E. Michelbacher, D. D. Jensen, K. E. Frick, D. W. Boddy, W. W. Middlekauff, E. C. Van Dyke, E. O. Essig, R. F. Smith, A. J. Walz, H. B. Leech, T. O. Thatcher, L. M. Henry, G. F. Ferris, B. D. Culver, F. E. Skinner, P. H. Arnaud, F. J. Driver, H. P. Chandler, Mrs. H. P. Chandler, W. D. Murray, C. P. Hoyt, W. W. Wirth, E. E. Seibert, C. H. Hanson, E. S. Ross, C. H. Spitzer, Jr., D. H. Bixby, P. A. Adams, A. E. Pritchard, G. L. Smith, P. D. Hurd, Jr., J. W. MacSwain, W. W. Sampson, J. W. Tilden, J. P. Harville, R. E. Beer, P. A. Harvey, J. R. Walker, R. C. Miller, W. Russell, E. L. Kessel, B. B. Kessel, H. A. Scullen, E. G. Wegenek, H. T. Reynolds, and H. H. Blakemore. Visitors were present as follows: Ruth F. Hanke, Wm. L. Hoyt, L. L. Lewallen, Mrs. J. W. Tilden, Thomas Leigh and W. A. McDonald.

The minutes of the previous meeting were read and approved.

The membership committee proposed the following for membership in the Society: Richard W. Coleman, I. Barry Tarshis, Frank A. Ehrenford, Vernon M. Stern, Francis Leigh, and Frederick Rindge. They were unanimously elected.

President Michelbacher appointed the following members as a committee to investigate possible localities for the April field trip of the Society: Mr. J. W. MacSwain (Chairman), Dr. E. S. Ross, and Miss Laura Henry. The committee is to report its recommendations at the March meeting.

The chair called for notes, exhibits, and remarks. Dr. Middlekauff displayed a new species of sawfly of the family Siricidae, collected in Berkeley, California, 1932, on white fir. This is the first new species in this family reported in North America since Bradley's work in 1913.

Mr. MacSwain reported on four egg masses of *Meloe strigulosus* Mann. laid by adults collected in the Oakland Hills between December and February. Of the eggs showing development, over 75 per cent of the larvae were abnormal. Several slides were exhibited showing many larval abnormalities including one individual from which the head and prothorax were completely lacking and which possessed only one meso-thoracic leg, the metathorax and abdomen being normal.

Mr. H. B. Leech exhibited two new entomological publications, a new book by A. D. Imms entitled "Insect Natural History" and the 44th Annual Volume of the Entomological Society of British Columbia.

Professor H. A. Scullen, a member of the Society, visiting from Oregon State College was introduced to the members present and expressed his pleasure at attending the meeting.

President Michelbacher introduced the main speaker of the meeting, Dr. W. W. Middlekauff, who presented a paper, with ac-

companying lantern slide illustrations, entitled "Bionomics of Some American Sawfly Larvae." A summary of Dr. Middlekauff's remarks follows:

With the exception of the parasitic family Orussidae, sawfly larvae are completely phytophagous. The commonest hosts are all very primitive plants and include ferns, conifers, grasses and sedges, willows, alders, hickories, oaks, and almost every native genus of Rosaceae. There are sawflies which feed on other hosts, but aside from those named, few sawfly larvae attack them. Thus only a few species feed on such specialized plant families as the Ericaceae, Caprifoliaceae, and Compositae.

A few sawfly groups are very narrowly restricted in host range. The family Diprionidae feeds only on pines, most of the subfamily Selandriinae only on ferns, and in other groups many genera are confined to a single plant genus. Conversely a few groups such as the Nematinae show a great range of host species amongst the various genera.

Sawfly larvae may be segregated into the following categories, based upon their feeding habits.

1. Free leaf feeders—majority of Tenthredinoidea and Xyelidae.
2. Leaf miners—several genera of Phyllotominae, several species of Argidae, and one species of Nematinae. Caulocampus acericaulis mines the petioles of maples.
3. Web spinners—family Pamphiliidae.
4. Wood and stem borers—Siricidae, Xiphydriidae, and Cephidae.
5. Gall makers—*Lycaotella, Pontania,* and *Euura.*
6. Fruit eaters—Hoplocampinae.
7. Parasitic—*Orussus.*

Larval Feeding Habits. Sawfly larvae may be gregarious or solitary in feeding habits. This is controlled to a great extent by the female and her manner of depositing eggs. It is a constant feature for a species, however. The great majority of leaf-feeding sawflies are edge feeders and many species have characteristic feeding postures. Habits of several species were discussed in detail and the manner in which the larvae of Siricidae and Cephidae prepare for their escape as adults was mentioned.

It has recently been shown that Siricidae have symbiotic fungi living in association with them. Spores of a Basidiomycete are inoculated into the egg tunnel and the developing mycelia are utilized by the larvae in digesting wood particles.

Protective glands are possessed by many species of sawflies on the external surface of their bodies which secrete fluids, slime, or wax. Examples of several types were given.

Difficulties in rearing and methods of pupation were also discussed.

At the conclusion of a discussion of the paper the meeting was adjourned.—D. D. JENSEN, *Secretary.*

One Hundred and Ninety-ninth Meeting

The one hundred and ninety-ninth meeting of the Pacific Coast Entomological Society was held at 2:25 p.m. on March 20, 1948, in the entomological laboratories of the California Academy of Sciences, San Francisco. President Michelbacher in the chair. The following members were present: E. S. Ross, J. W. MacSwain, R. F. Smith, E. L. Kessel, B. B. Kessel, C. H. Spitzer, P. H. Arnaud, C. P. Hoyt, R. L. Doutt, L. R. Gillogly, K. S. Hagen, P. D. Hurd, Jr., K. E. Frick, W. W. Wirth, W. W. Middlekauff, P. A. Adams, D. Bixby, J. R. Walker, C. Donald Grant, B. D. Culver, J. F. Gustafson, L. M. Henry, A. E. Pritchard, W. D. Murray, D. W. Boddy, J. P. Harville, E. A. Smith, J. W. Tilden, G. F. Ferris, E. O. Essig, H. B. Leech, E. C. Van Dyke, B. Walker, C. D. Duncan, R. L. Usinger, A. E. Michelbacher, and D. D. Jensen. The following visitors were present: S. R. Hildebrandt, V. M. Walker, H. S. Elmer, W. L. Kaiser, Jr., A. G. Applegarth, Mrs. E. A. Smith, and Mrs. J. W. Tilden.

The minutes of the previous meeting held February 28, 1948, were read and approved.

The membership committee proposed and the Society unanimously elected Lawrence L. Lewallen and W. C. Day as members of the Society.

Reporting for the committee assigned to select a locality for the April field trip, Mr. MacSwain stated that Rock City, Mt. Diablo had been chosen as the site for the outing. The date proposed was Sunday, April 18, 1948.

By a unanimous vote of the members present, Dr. Usinger was authorized to serve as the official representative of the Pacific Coast Entomological Society at the 13th International Congress of Zoology to be held at Paris, France, July 21 to 27, 1948, and also at the 8th International Congress of Entomology at Stockholm, Sweden, August 9 to 14, 1948.

The chairman then called for notes, exhibits and remarks.

Dr. E. L. Kessel exhibited three live male specimens of *Empimorpha geneatis* Melander (Empididae) (see Pan-Pacific Ent. 23: 181-192) and the small white balloon each had been carrying at the time of capture. They had been collected near Monterey Pines at Mill Valley, California, and were kept alive in the hope that they would still be holding the balloon at the time of the meeting. However, each had dropped its balloon by releasing the single, small hymenopteron or dipteron which adhered to the balloon and which served *E. geneatis* as a handle in carrying the balloon.

Mr. Gillogly exhibited examples of "Kodagraph" contact paper which can be used in copying published articles. The paper is merely placed over the page, exposed to light, and developed. The result is a negative which can be used in making a positive print

or can be read from the back by holding the negative between the reader and a light source.

Professor Ferris stated that the work which Miss Laura Henry has been carrying out on the nervous system of the lower invertebrates has elucidated the question regarding the origin of the hypopharnyx in insects. Her work on the nerves shows that the hypopharynx belongs to the second or clypeal segment. The evidence to support this conclusion is consistent all the way from the oligochaete worms up through the Crustacea to and including the insects.

Dr. Usinger reported that Dr. Richard Goldschmidt, of the University of California, has been rearing *Drosophila* flies which bear extra appendages on the legs. Among the aberrant individuals produced was one with the prothoracic legs fused in such a manner that they simulated a perfect labium showing the mentum, submentum, palpus, etc.

Dr. Ross announced that the Society's pamphlet collection became depleted when everything on hand was sent to the Philippine Islands to help rebuild the library at Los Banos which was destroyed during the war. Previously miscellaneous pamphlets which were turned in to the Society could be purchased by members at a low cost.

President Michelbacher introduced, as the main speaker of the meeting, Mr. J. W. Tilden of Stanford University who spoke on the subject, "The Insect Fauna of *Baccharis pilularis*." *Baccharis pilularis* De Candolle is a dioecious fruticose composite, described in 1836, apparent type locality San Francisco. According to C. B. Wolf, 1935, it occurs in two subspecies: *typica* Wolf, the prostrate coastal form, and *consanguinea* De Candolle, the taller inland form. However, both subspecies occur together, and are genetic segregates. As a species, *pilularis* is invasive, pioneering disturbed areas, and is inclined to form "microsavannahs" in grasslands.

Its seasonal growth is correlated with the amount of available water in the soil, and maximum seasonal growth occurs during the rainy season, beginning in the late fall and extending into June. The maximum insect populations on the plants coincide with this period of greatest growth.

The total complex of insects found to be associated with *Baccharis pilularis* is 226 species. Of these, 165 species are dependent to a greater or lesser extent upon the plant or upon other species of insects that are so associated. Percentages of orders and types of life habits were presented for the insects composing this group of species.

Food chains and food cycles were discussed, and three were presented in some detail. In the cycle of which *Gnorimoschema baccharisella* Busck is the basic or "key" industry, it was found that there are ten primary parasites, two secondary parasites, and one tertiary parasite of this moth. In addition to the moth and its

parasites, ten species of other insects are associated with the gall of *baccharisella*, utilizing it for food and shelter.

Other aspects of this complex of insects were discussed, including competition, dominance, inquilines, and phenology. It was noted also that certain species exhibit a sense of territory and at least one species makes daily altitudinal movements. There is an interaction among the members of this complex, and the included members may be regarded as constituting a community, although not in the strictest classical sense of the word.

After a discussion of the paper, the meeting was adjourned at 4:00 p.m.—D. D. JENSEN, *Secretary*.

Two Hundredth Meeting

The annual field meeting of the Pacific Coast Entomological Society was held at Mt. Diablo, Contra Costa County, California, on April 18, 1948.

The recorded attendance was 97 persons. The following 36 members were present: D. Raski, M. W. Allen, D. D. Jensen, E. E. Siebert, W. W. Wirth, P. D Hurd, Jr., Deane Furman, R. L. Usinger, Francis Leigh, H. F. Madsen, K. E. Frick, F. H. Rindge, N. W. Hazel, D. W. Adams, J. W. MacSwain, R. G. Wind, J. P. Harville, I. B. Tarshis, U. N. Lanham, J. W. Tilden, E. A. Smith, J. R. Walker, M. Marquis, H. B. Leech, D. H. Bixby, P. A. Adams, E. O. Essig, A. E. Michelbacher, W. W. Middlekauff, W. H. Hart, R. M. Bohart, W. C. Day, W. H. Lange, A. T. McClay, A. E. Pritchard, and H. E. Cott. Thirty-eight adult visitors and 23 children were present as follows: Mrs. D. Laski, Mrs. M. W. Allen, Mrs. D. P. Furman, K. Sakimura, R. D. Carter, Mrs. R. L. Usinger and family, Mr. and Mrs. Bertram Leigh, Mr. A. Bartel, Mrs. N. Hazel, Mrs. D. W. Adams, Mr. Eric C. Winkler, Mr. A. S. Tahon, Mrs. A. E. Pritchard and family, Mrs. W. W. Wirth and family, Mrs. J. P. Harville, Mrs. W. H. Hart, Mr. and Mrs. H. Zaiman, Mrs. I. B. Tarshis, Mrs. W. W. Middlekauff and family, Mrs. K. E. Frick, Mrs. H. F. Madsen and family, Mrs. M. Texeira, Mr. D. V. Welsch, Mrs. J. W. Tilden, Mrs. J. R. Walker and family, Mrs. E. A. Smith and family, Mrs. M. Marquis, Mrs A. E. Michelbacher, Mrs. M. Mauerhan, Mrs. H. B. Leech and family, Mr. J. W. Quail, Mrs. D. D. Jensen and family, Mrs. R. M. Bohart, Mrs. W. C. Day and family, Mrs. W. H. Lange and family, and Mrs. A. T. McClay.

The spring season of 1948 was approximately two weeks later than normal, and the weather for several weeks prior to April 18 had been cold and stormy. However, on the day of the field meeting the sun was shining and the air was warm and relatively still at Rock City. The members of the group enjoyed themselves by collecting, hiking and visiting.—D. D. JENSEN, *Secretary*.

Two Hundred and First Meeting

The two hundred and first meeting of the Pacific Coast Entomological Society was held at 2:00 p.m. on October 23, 1948, in the entomological laboratories of the California Academy of Sciences, San Francisco. President Michelbacher in the chair. The following members were present: W. C. Day, E. C. Van Dyke, W. Harry Lange, J. W. MacSwain, H. B. Leech, Herbert Blakemore, J. W. Tilden, E. G. Wegenek, A. E. Pritchard, W. D. Murray, K. S. Hagen, Laura M. Henry, R. W. S. Potts, L. L. Lewallen, P. H. Arnaud, C. P. Hoyt, K. E. Frick, F. H. Rindge, W. W. Wirth, Bernard Brookman, E. S. Ross, S. E. Hall, Jr., P. D. Hurd, Jr., D. B. Scott, E. G. Meyers, J. R. Walker, E. A. Smith, C. H. Spitzer, C. D. Duncan, P. A. Adams, A. W. Larson, A. E. Michelbacher, D. D. Jensen, B. D. Culver, and E. G. Linsley. Visitors were present as follows: K. W. Tucker, W. K. Bauman, S. A. Sher, L. W. Quate, Iris Wegenek, R. F. Fritz, A. H. Bartel, Wm. Hazeltine, J. M. Watson, Claude Smith, R. L. Langston, J. E. Gillaspy, N. D. Waters, S. E. Hall, Jr., Douglas Gould, Bernard Gardner, Mrs. E. A. Smith, N. G. Gratz, Patricia Readnig, Sylvia R. Hildebrant, Pauline S. Lange, Victor Stombler, J. Gordon Edwards, G. Carter, and Andrew Browne.

The minutes of the meeting held February 28, 1948, and of the field meeting held April 18, 1948, were read and approved.

The membership committee proposed and the Society unanimously elected the following as members of the Society: Dr. Francis X. Williams, Phyllis Johnson, Harold S. Elmer, Stanley H. Benedict, Samuel A. Sher, Don W. Adams, Douglas Gould, J. Gordon Edwards, Wilfred K. Bauman, Walter E. Kelson, Larry Quate, James E. Gillaspy, John F. Hart, R. S. Beal, Jr., Eugene Morris, Victor Stombler, John M. Watson, Arthur Retan and William Hazeltine.

President Michelbacher called attention to the fact that the 50th anniversary of the Society will occur in less than two years and that plans should be made to commemorate the occasion appropriately.

Dr. Linsley, a member of the Nomenclature Committee, at the request of the president, reported the results of the meetings held by the International Commission on Zoological Nomenclature at the 13th International Congress of Zoology held at Paris, France, July 21 to 27, 1948.

President Michelbacher appointed the following members to serve as a Nominating Committee to select a slate of proposed officers for the year 1949 to be presented at the December meeting: Dr. R. F. Smith (Chairman), Dr. C. D. Duncan and Dr. E. C. Van Dyke.

The president then called for notes, exhibits and remarks.

Mr. MacSwain exhibited a gynandromorph of *Xylocopa orpifix*, on which the left side was male and the right side was female

all the way through the body from the anterior end to the posterior end.

Mr. Tilden displayed a photomicrograph of the genitalia of *Caicella mysie* (Dyar), a hesperiid. The picture was taken by a special process, originated by Lester Brubaker of San Jose State College, which shows promise of facilitating some types of entomological illustration.

Mr. E. A. Smith exhibited a case of mutillid wasps (*Dasymutilla* spp.) which had been collected near Los Banos, California, where they were eating the bracts of Australian saltbush, *Atriplex semibaccata* R. Br.

Mr. Frick reported the following observations, made during the past summer in California, on an unusual feeding habit of the predaceous larvae of *Chrysopa* sp. At Mount Herman a chrysopid larva was found feeding on a half-emerged larva of a species of *Dizygomyza* (Agromyzidae). The fly larva was cutting its way out of its mine on the lower surface of a Brackin fern leaf.

At Hope Valley, Alpine County, a chrysopid larva was found with the ends of both mandibles projecting through the lower surface of a leaf of *Lonicera conjugialis*. Microscopic examination showed the mandible holes were located on either side of an agromyzid mine, but no fly larva occurred at this spot. This may have been random searching.

At the summit of Luther Pass, El Dorado County, a chrysopid larva was found on the lower surface of a leaf feeding on a large larva of *Pegomyia* sp. (Anthomyiidae). Both mandibles penetrated the lower leaf surface and were imbedded in the prey. Subsequent examination under a binocular microscope revealed a shrunken larva at the feeding site. This species of *Pegomyia* makes large blotch mines in *Polygonum alpinum*.

On *Symphoricarpos albus* (snowberry), on the Berkeley campus, a chrysopid larva was observed attempting to feed upon an old puparium (*Phytomyza* sp. from which the adult agromyzid had already emerged. The chrysopid larva repeatedly opened and closed its mandibles on the puparium, each time in a different place. Since the puparium occurred beneath the upper epidermis of the leaf, the chrysopid larva may have found it by random searching.

Three of the four *Chrysopa* larvae were subsequently reared to the adult stage by feeding them on aphids.

The president presented Dr. W. Harry Lange, Jr., of the University of California, who gave an illustrated talk on "Entomological Observations in the Pacific and Malaysian Areas." A summary of his remarks follows:

The Pacific Science Board of the National Research Council has initiated a number of insect control projects at the request of the navy. The primary purpose of the work is to control insects

or other organisms seriously damaging crops which are of greatest economic value to the natives. One of these projects was a joint one dealing with the life histories and controls of the Mariana coconut beetle, *Brontispa mariana* Spaeth, and the giant African snail, *Achatina fulica* Ferussac. The project began in October, 1947, and extended until the end of March, 1948. After a period of one month on Saipan a search was made for parasites of the coconut beetle in the Philippines, Malaya, and Java. In the Philippines a search in the vicinity of Los Banos, Luzon, revealed no parasites of possible value, although *Plesispa reichei,* an externally-feeding hispid, and *Promecotheca cumingi,* a leaf miner of coconut were found. In Malaya, headquarters were established at Kuala Lumpur where two entomologists are stationed, H. T. Pagden, and R. A. W. Lever. The genus *Brontispa* does not occur in Malaya, but several parasites of other externally feeding hispids were found. An egg parasite of *Plesispa nipa* on nipa palm, *Haeckeliana brontispae* Ferr., was found parasitizing 60 per cent of the eggs of this beetle near Klang. A pupal parasite of *Plesispa nipa* was found, *Tetrastichus brontispae* (Ferr.). On *Wallacea palmarum* feeding on Chinese betel nut, a parasite was found emerging through the mature larva, namely, an *Achrysocharis* sp. Several other parasites were obtained from individual rearings. Of these parasites, *Haeckeliana brontispae* and *Testrastichus brontispae* were successfully introduced to Saipan. A trip was made to Java to study the parasites of *Brontispa longissima javana* and *B. longissima selebensis,* which occur together on coconuts and cause damage to coconuts in a similar manner to *B. mariana.* The Dutch under Dr. van der Vecht successfully bred *Tetrastichus brontispae* for introduction to Celebes before the war, and they cooperated by breeding parasites for this project. About 600 parasitized beetle pupae containing *T. brontispae* were successfully brought to Saipan, and a few *Haeckeliana brontispae* for laboratory work. Both parasites were found to select *Brontispa mariana,* although it was difficult to rear the egg parasites and a high mortality occurred. Approximately 4,000 *Tetrastichus* parasites were liberated on Saipan and several hundred on Rota. About 300 *Haeckeliana* egg parasites were also liberated on Saipan and a few on Rota.

According to a recent survey by Dr. Richard Doutt the pupal parasite, *Tetrastichus brontispae* was found to be successfully established in six of seven localities on Saipan and gave evidence of having experienced some degree of natural spread. The egg parasite was not found, although there was evidence that it went through one generation before disappearing.

In Malaya, Mr. T. R. Gardner collected a scoliid wasp, *Scolia patricialis* var. which was introduced into the Palau Islands for control of the rhinocerus beetle. *Scolia procer* was reported in the literature on *Orcytes* in Malaya, but this wasp was found to probably select other woodboring grubs and not *Oryctes.*

On Saipan a study was made of the life history of the giant African snail, but time was not available for a complete study The life history varies apparently with climatic conditions and available food On Saipan snails are most active during the rainy season, at which time mating and egg laying occur. The snails are catholic in their tastes, feeding on all types of vegetation, dried leaves, fruits, and even manure.

The snail is successfully controlled in larger areas through the use of pelletted snail baits. Dr. F. X. Williams was sent to Africa to secure parasites and predators and was able to find several predacious snails, a large predacious carabid beetle, and a fly parasite.

After a discussion of Dr. Lange's talk the meeting was adjourned.—D. D. JENSEN, *Secretary.*

Two Hundred and Second Meeting

The two hundred and second meeting of the Pacific Coast Entomological Society was held at 2:00 p.m. on December 18, 1948, in the entomological laboratories of the California Academy of Sciences, San Francisco. President Michelbacher in the chair. The following members were present: E. C. Van Dyke, C. A. Hanson, E. G. Wegenek, F. X. Williams, H. M. Armitage, R. C. Miller, J. W. MacSwain, E. L. Kessel, W. W. Middlekauff, E. G. Linsley, L. W. Quate, C. H. Spitzer, Jr., J. W. Tilden, L. L. Lewallen, P. H. Arnaud, Jr., C. D. Duncan, B. E. Rees, L. R. Gillogly, R. P. Allen, A. W. Larson, J. Gillaspy, W. W. Wirth, Ernestine B. Thurman, D. C. Thurman, A. E. Pritchard, D. D. Jensen, J. F. Hart, A. E. Michelbacher, and E. E. Seibert. Visitors present were Sylvia R. Hildebrant and G. F. Carter.

The minutes of the meeting held October 23, 1948, were read and approved.

The membership committee proposed and the Society unanimously elected the following as members of the Society: Norman G. Gratz, Roy. F. Fritz, Roberto Levi Castillo, G. F. Carter, D. C. Thurman, Ernestine B. Thurman, John J. Roland, Omar E. Myers, Norman D. Waters, Claude I. Smith, Rudolf H. T. Matton, Howard Greenfield, C. F. Adams, G. F. Augustson, James Baker, H. G. Barber, Herbert S. Barber, J. C. Bequaert, F. Martin Brown, L. R. Cody, John F. Curry, W. M. Davidson, Heber C. Donohoe, R. R. Dreisbach, J. W. Green, Harry A. Hill, George F. Knowlton, Frank H. Lathrop, Borys Malkin, Don C. Mote, Herbert Osborn, Wm. Proctor, L. P. Rockwood, Herbert Ruckes, E. Graywood Smyth, Stanley Watkins., Raymond G. White, and Kent H. Wilson.

President Michelbacher called on Dr. Linsley who reported that the Nomenclature Committee is in correspondence with Mr. Hemming, Secretary of the International Commission on Zoological Nomenclature regarding the proposed revision of the International Rules.

Dr. Miller gave the Treasurer's report on the finances of the Society. Dr. Rees reported that the auditing committee had found the Society's financial records in good order.

Mr. Armitage stated that the selection of Oriental fruit fly as the common name of *Dacus dorsalis* Hendel, recently established in Hawaii, was unfortunate because of the possibility of confusion with the name Oriental fruit moth. He also questioned the desirability of having official common names of insects decided upon by a committee of ten entomologists appointed by the American Association of Economic Entomologists.

Dr. Linsley reviewed the history of the Committee on Common Names and suggested that advance publication of proposed names would give the committee the benefit of public reaction before making the final selection of a name.

In response to the President's call for notes, exhibits and remarks, Dr. Kessel stated that a loose leaf system of color identification is now available which permits relatively definite determination of any color which one may encounter.

Mr. Armitage reported on some of the insect records established by the California Department of Agriculture during 1948. Included were notes on the walnut huskfly, the navel orangeworm, olive scale, chrysanthemum insects, and the Australian sod fly. The sod fly was recently discovered in North America for the first time when it was found in San Francisco by Dr. Kessel.

President Michelbacher, reporting on the state of the Society during 1948, announced the unexpected death of one of the younger members, Mr. Loren Estabrook who died December 1, 1948, at Stockton, California, during a tonsillectomy. A summary of membership in the Society during recent years revealed an increase in membership from 119 in 1940 to 251 in 1948. The average attendance per meeting during 1940 was 29 and during 1941 it was 31. During the war years of 1942-1945 attendance averaged only 17 per meeting. In 1946 and 1947 attendance averaged 47 and 43 respectively. Attendance at the first five meetings during 1948 increased to an average of 60 members and friends per meeting.

Dr. Duncan, representing the nominating committee, proposed and the Society elected the following officers for 1949: E. S. Ross, President; G. F. Ferris, Vice-President; D. D. Jensen, Secretary; R. C. Miller, Treasurer; and E. L. Kessel, Executive Board Member at Large.

In the absence of both the president elect and vice-president elect, President Michelbacher turned the meeting over to Dr. Jensen. President Michelbacher was then called on to give his retiring presidential address entitled "The Ecology of Symphyla." (This address will be published in full in the Pan-Pacific Entomologist.) After considerable discussion of the paper, the meeting was adjourned.—D. D. JENSEN, *Secretary.*